THE CHARLES STARK DRAPER LABORATORY
A DIVISION OF MASSACHUSETTS INSTITUTE OF TECHNOLOGY
68 ALBANY STREET
CAMBRIDGE, MASSACHUSETTS 02139

LUMINARY MEMO #230

To: Distribution
From: L. Berman
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Subject: EFFECT ON ASCENT OF INCORRECT TIME IN AGC

The Ascent Guidance operates in a coordinate system based on the orbit of the CSM. The position of the LM is derived from $\bar{R}$LS and time. If, as has been suggested, the CSM state and the AGC time are updated only occassionally, then the assumed relationship between the LM position and the CSM orbit will be incorrect. The CSM orbit has a precessional rate due to non-sphericity of the moon, and the LM has a motion due to the lunar rotation rate.

The first item, in the case of Apollo 15 was $+.06^{\circ}$/hr (east). This will vary with the CSM orbit. The second item is 0.55°/hr (east). The two combine to give the effective drift of the CSM orbit (or the LM position).

The total drift will affect the cross plane distance from the LM to the CSM orbit. It seems feasible to provide a chart or table to allow the crew to adjust "Cross Range" when it is displayed in Noun 76 to compensate for the drift. While the actual rate is dependent on $\bar{R}$LS and the $\bar{C}$SM orbit, the maximum drift rate can be seen to occur if $\bar{R}$LS is near the line of nodes of the CSM orbit. In that case, it is easy to see that

$Y = RW_m \sin i$, where R = lunar radius
Wm = lunar rotation rate
i = inclination of CSM orbit.

If we leave out the physical precession of the CSM orbit, since it will be a function of the orbit involved,

$$\dot{Y} = .55^{\circ}/\text{hr} \times -6.42 \text{ n mi/a} \sin i$$
$$= 9.03 \text{ n mi/hr} \sin i$$

assuming i is a small angle

$$\sin i = i = i(^{\circ})/57.3$$

then $\dot{Y} = .18\, i$ n mi/hr (i in degrees)

If i 0, Y increases with time
i 0, Y decreases with time.